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Claims:

1. A process for the production of a sulfonated polymer membrane, according to which process

- a polymer membrane material is irradiated and
- the irradiated polymer membrane material is sulfonated in order to link sulfonic acid groups to it,

c h a r a c t e r i z e d in that

- the sulfonation is continued until the total concentration of sulfonic acid groups in the membrane is 0.4 – 3.0 meq/g and they are homogeneously distributed in the membrane material so that their concentration in the middle of the membrane is at least 0.2 meq/g and

- the polymer membrane material is self-supporting and non-aromatic.

2. The process according to claim 1, c h a r a c t e r i z e d in that the irradiation is carried out as ion or gamma irradiation.

3. The process according to claim 2, c h a r a c t e r i z e d in that the radiation dose is 50 – 1500 kGy.

4. The process according to any of claims 1 – 3, c h a r a c t e r i z e d in that the sulfonation is carried out in a gas phase.

5. The process according to claim 4, c h a r a c t e r i z e d in that the sulfonation reagent is a sulfur compound, such as chlorosulfonic acid, oleum, SO_2 or SO_3, which is in the gas phase at the sulfonation temperature.

6. The process according to any of claims 1 – 3, c h a r a c t e r i z e d in that the sulfonation is carried out in a solution phase.

7. The process according to claim 6, c h a r a c t e r i z e d in that a solution of chlorosulfonic acid and a chlorinated hydrocarbon, for example, dichloroethane, is used for the sulfonation.

8. The process according to claim 7, c h a r a c t e r i z e d in that the concentration of chlorosulfonic acid in the solution is 0.1 – 1.5 % by volume.

9. The process according to any of the preceding claims, c h a r a c t e r i z e d in that any excess of sulfonation reagent is removed from the sulfonated polymer membrane by evaporation under reduced pressure or normal atmospheric pressure or by washing with one or more solvents with the help of pressure or under normal pressure, or by a combination of two or more of the above-mentioned methods.

10 The membrane according to any of the preceding claims, c h a r a c t e r i z e d in that the membrane material used is polyethylene (PE), polypropylene (PP), polyhexafluoropropylene, polychlorotrifluoroethylene, polytetrafluoroethylene (PTFE), polyvinyl fluoride (PVF), polyvinylidene fluoride (PVDF), and/or copolymers or blends thereof.

11. A sulfonated polymer membrane comprising

- a non-aromatic membrane material which is self-supporting, and
- sulfonic acid groups linked to the membrane material,

c h a r a c t e r i z e d in that

- the sulfonic acid groups are linked directly to the linear carbon backbone of the polymer chain of the polymeric membrane material, and
- the total concentration of sulfonic acid groups in the membrane is 0.4 – 3.0 meq/g, and they are homogeneously distributed in the membrane material so that their concentration in the middle of the membrane is at least 0.2 meq/g.

12. The membrane according to claim 11, c h a r a c t e r i z e d in that the total concentration of sulfonic acid groups in the membrane is 0.5 – 1.5 meq/g.

13. The membrane according to claim 11 or 12, c h a r a c t e r i z e d in that the membrane material comprises at least two films placed one on top of the other, the films being mutually of the same material or of different materials, which materials are, however, compatible so that they can be attached to each other.

14. The membrane according to any of claims 11 – 13, c h a r a c t e r i z e d in that the membrane material used is polyethylene (PE), polypropylene (PP), polyhexafluoropropylene, polychlorotrifluoroethylene, polytetrafluoroethylene (PTFE), polyvinyl fluoride (PVF), polyvinylidene fluoride (PVDF), and/or copolymers or blends thereof.

15. The membrane according to any of claims 11 – 14, c h a r a c t e r i z e d in that the ion exchange capacity of the membrane is 0.1 – 5 meq/g.

16. The membrane according to any of claims 11 – 15, c h a r a c t e r i z e d in that the thickness of the membrane is 5 – 200 µm, preferably 30 – 60 µm.

17. The use of a membrane according to any of Claims 11 – 16 in an electrochemical cell.

18. An electrochemical cell which comprises

- a first plate,
- a second plate placed at a distance from the first plate, and
- at least one membrane-electrode assembly fitted between the first and the second plates, the assembly comprising
  - a first porous electrode,
  - a second porous electrode placed at a distance from the first electrode,
  - a membrane fitted between the first and the second electrode,
  - first feeding units for feeding fuel to the first electrode,
  - second feeding units for feeding an oxidant to the second electrode, and
  - electric switching elements which enable electric switching between the first and the second electrode,

c h a r a c t e r i z e d in that the membrane material of the membrane is a non-aromatic polymer film which comprises sulfonic acid groups linked directly to the linear carbon backbone of the polymer chain of the polymer in such a manner that the total concentration of sulfonic acid groups in the membrane is 0.4 – 3 meq/g and they are homogeneously distributed in the membrane material so that their concentration in the middle of the membrane is at minimum 0.2 meq/g.